

03/30/98  
JC545 U.S. PTO

FORM 1082

FORM PTO-1082

THE ASSISTANT COMMISSIONER FOR PATENTS  
Washington, D C 20231

File Number. MAT-5860

Sir

Transmitted herewith for filing is the patent application of

Inventor Yutaka Machida

For DECODING AND CODING METHOD OF MOVING IMAGE SIGNAL, AND DECODING AND CODING APPARATUS OF MOVING IMAGE SIGNAL USING THE SAME

Enclosed are:

- 6 sheets of drawing.
- An assignment of the invention to \_\_\_\_\_.
- A Declaration and Power of Attorney (UNEXECUTED).
- A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.2
- Claim to Right of Priority w/certified copy of Japanese application no(s). 9-094478.
- Information Disclosure Statement

The filing fee has been calculated as shown below:

(Col. 1)	(Col. 2)	
FOR:	No. Filed	No. Extra
Basic Fee		
Total Claims	11-20=	0*
Indep Claims	5-3=	2*
<input type="checkbox"/> Multiple Dependent Claim Presented		

\*If the difference in Col 1 is less than zero,  
enter "0" in Col 2

SMALL ENTITY

Rate	Fee
	\$395
x \$11	\$
x \$41	\$
+ \$135	\$
<b>TOTAL</b>	\$

OTHER THAN A  
SMALL ENTITY

OR	Rate	Fee
OR	\$	790
OR	x \$22	\$
OR	x \$82	\$ 164
OR	+ \$270	\$
OR	<b>TOTAL</b>	\$ 954

- Please charge my Deposit Account No 18-0350 the amount of \$ . A duplicate copy of this sheet is enclosed.
- A check in the amount of **\$954.00** to cover the filing fee is enclosed.
- The Assistant Commissioner for Patents is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 18-0350 . A duplicate copy of this sheet is enclosed
  - Any additional filing fees required under 37 CFR 1.16.
  - Any patent application processing fees under 37 CFR 1.17.
- The Assistant Commissioner for Patents is hereby authorized to charge payment of the following fees during the pendency of this application or credit any overpayment to Deposit Account No. 18-0350 . A duplicate copy of this sheet is enclosed
  - Any patent application processing fees under 37 CFR 1.17.
  - The issue fee set in 37 CFR 1.18 at or before mailing of the Notice of Allowance, pursuant to 37 CFR 1.311(b).
  - Any filing fees under 37 CFR 1.16 for presentation of extra claims

RATNER AND PRESTIA  
Suite 301,  
One Westlakes, Berwyn  
P. O. Box 980  
Valley Forge, PA 19482-0980  
(610) 407-0700

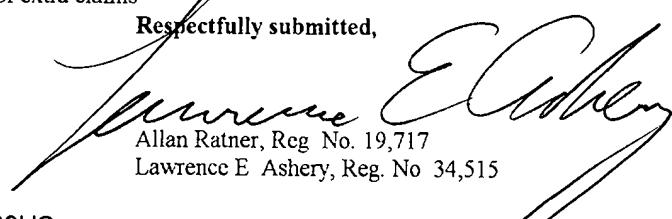
dlm

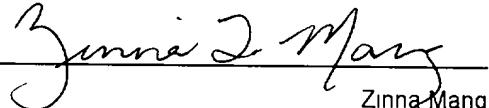
EXPRESS MAIL Mailing Label Number:EL063282909US

Date of Deposit: March 30, 1998

I hereby certify that this paper and fee are being deposited, under 37 C.F.R. § 1.10 and with sufficient postage, using the "Express Mail Post Office to Addressee" service of the United States Postal Service on the date indicated above and that the deposit is addressed to the Assistant Commissioner for Patents, Washington, D C 20231.

Respectfully submitted,

  
Allan Ratner, Reg. No. 19,717  
Lawrence E. Ashery, Reg. No. 34,515

  
Zinna Mang

DECODING AND CODING METHOD OF MOVING IMAGE SIGNAL, AND  
DECODING AND CODING APPARATUS OF MOVING IMAGE SIGNAL  
USING THE SAME

**FIELD OF THE INVENTION**

5 The present invention relates to a decoding method and coding method of digital moving image signal, and a decoding apparatus and coding apparatus using the same methods, for use in television telephone, television conference, and recording of video signals and communication of various signals. More particularly, it relates to a decoding method and coding method of digital 10 moving image signal, and a decoding apparatus and coding apparatus using the same, being designed so that effects of decoding errors may not propagate to frames and fields later in time.

**BACKGROUND OF THE INVENTION**

15 In television telephone or television conference, in order to transmit a moving image efficiently even in a narrow transmission route, the moving image is digitized, and this signal is further processed by digital image compression, and is transmitted, and at the receiving side, the compressed digital moving image signal is decoded, and the moving image is reproduced.

20 In a video disc or the like, in order to accumulate more moving images in one disc, the digital moving image signal is coded and the image is compressed.

The conventional coding method and decoding method of digital moving image signal include the ITU-T Recommendation H. 261 recommended in March 1993, and the MPEG by the ISO, and the ITU-T Recommendation is mainly described in this specification. For the sake of convenience, the coding 5 method is first described, and then the decoding method, by referring to Fig. 4 to Fig. 6.

The coding method of H. 261 is realized, as shown in Fig. 4, by a coding apparatus comprising motion vector detecting means 401, motion compensation means 402, prediction error calculating means 403, intra-inter 10 judging means 404, DCT 405, quantizing means 406, variable length coding means 407, inverse quantizing means 408, inverse DCT 409, reconstruction means 410, frame memory 411, and intra/inter switch 412.

Each constituent element of H. 261 coding method is described below. First, the motion vector detecting means 401 detects the motion vector 15 between a previous reconstruction frame stored in the frame memory 411, and an entered present frame. The motion vector is detected, as shown in Fig. 5, in a unit of pixel block called macro block. The motion vector may be regarded as a spatial displacement amount of pixel block between the previous reconstruction frame and the present frame. Next, the motion compensation means 402 displaces 20 the pixel block of the previous reconstruction frame stored in the frame memory 411 according to the motion vector, and generates a predicted image. This motion compensation is a process for reducing the prediction error in the prediction error calculation at a next step.

The prediction error calculating means 403 calculates the differential 25 value between the macro block of the entered present frame and the predicted image in the pixel unit, and issues as a prediction error. Further, both the macro block of the present frame and the prediction error are entered into the intra/inter

judging means 404. Herein, for example, by comparison between the variance of pixels in the macro block of the present frame and the variance of the prediction error, it is judged whether coding is more efficient by directly coding the macro block of the present frame (intra-coding), or coding is more efficient by coding the prediction error (inter-coding), and according to the result, either the macro block of the present frame or the prediction error is issued. At the same time, the result of judgement is issued as an intra/inter control signal.

The macro block of the present frame or the prediction error issued from the intra/inter judging means 404 is transformed into a frequency region by the DCT 405 and is further transformed into a quantizing coefficient by the quantizing means 406 to be curtailed in redundancy, and further the quantizing coefficient is transformed into a variable length code on the basis of the statistic character by the variable length coding means 407, and the quantity of information is curtailed. In the variable length coding means 407, further, the intra/inter control signal and motion vector are entered, and coded into variable length codes. The variable length coding means 407 multiplexes all these variable length codes, and issues as a bit stream.

On the other hand, the quantizing coefficient which is the output of the quantizing means 406 is inversely quantized by the inverse quantizing means 408, and is inversely transformed from the frequency region by the inverse DCT 409. When the macro block being presently coded is intra-coding, the intra/inter switch 412 is turned off, and the output from the inverse DCT 409 is directly stored in the frame memory 411. To the contrary, when the macro block being presently coded is inter-coding, the intra/inter switch 412 is turned on, and the output of the inverse DCT 409 and the output of the motion compensation means 402 are added in the reconstruction means 410, and stored in the frame memory 411. Thus, the present reconstruction frame is stored in the frame memory 411,

and it is used in prediction of next frame.

Next, the decoding method of H. 261 is realized by an apparatus, as shown in Fig. 6, comprising variable length code decoding means 601, inverse quantizing means 602, inverse DCT 603, frame memory 604, motion compensation means 605, intra/inter switch 606, and reconstruction means 607.

Each constituent element of the H. 261 decoding method is described below. First, the variable length code decoding means 601 separates and decodes the variable length code from the entered bit stream, and issues the quantizing coefficient, intra/inter control signal, and motion vector in the macro block unit.

10 The quantizing coefficient is inversely quantized by the inverse quantizing means 602, and is inversely transformed from the frequency region by the inverse DCT 603. The motion compensation means 605 displaces the pixel block of the previous reconstruction frame stored in the frame memory 604, on the basis of the motion vector, and generates a predicted image.

15 When the intra/inter control signal instructs intra-coding, the intra/inter switch 606 is turned off, and the output from the inverse DCT 603 is directly stored in the frame memory 604. On the other hand, when the intra/inter control signal instructs inter-coding, the intra/inter switch 606 is turned on, and the output of the inverse DCT 603 and the output of the motion compensation means 605 are added in the reconstruction means 607, and stored in the frame memory 604. Thus, the present reconstruction frame is stored in the frame memory 604, and it is used in prediction of next frame and is also issued as a decoded image.

20 In the coding method and decoding method of H. 261, the inverse quantizing means, inverse DCT, and motion compensation means process the same, and therefore the reconstruction frames stored in the frame memory of the

coding method and decoding method always coincide with each other.

Generally, since the bit stream issued by the coding method of moving image signal is composed of variable length codes, in case an error occurs in transmission or accumulation, if it is an error of one bit, the decoding error occurs in a wide range, and the picture quality of the reconstruction frame deteriorates. In the conventional decoding method of moving image signal, the reconstruction frame lowered in picture quality due to decoding error is used in prediction of next frame, this picture quality deterioration can propagate to the succeeding frames later in time.

As one of the prior arts presenting a method of solving this problem, "Error Resilient Video Coding by Dynamic Replacing of Reference Pictures" (S. Fukunaka et al.) (1996 IEEE) is known, but when a decoding error occurs, the previously decoded video signal is directly used again, the improving effect of picture quality deterioration was trifling.

## 15 SUMMARY OF THE INVENTION

It is hence an object of the invention to present an excellent decoding method and coding method of digital moving image signal, and a decoding apparatus and coding apparatus using the same, capable of preventing propagation of picture quality deterioration in time even if a decoding error occurs due to bit error in the bit stream, and decoding with less picture quality deterioration.

Relating to the present processing pixel block, in the coding method and decoding method of digital moving image signal of the invention, at least two or more motion vectors are coded or decoded, and the motion of the decoded frame corresponding to each motion vector is compensated, and two or more predicted images relating to the present processing pixel block are generated. In

the decoding method of moving image signal of the invention, depending on the presence or absence of decoding error contained in the two or more predicted images, the predicted image to be used reconstruction of the present processing pixel block is selected.

5           According to the invention thus constituted, if decoding error occurs due to bit error in the bit stream, an excellent coding method and decoding method of digital moving image signal capable of suppressing propagation of picture quality deterioration in time can be presented.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

10           Fig. 1 is a drawing showing a constitution of a decoding apparatus for realizing a decoding method of moving image signal in first and second embodiments of the invention.

15           Fig. 2 is a diagram showing an estimating method of macro block having a decoding error in the decoding method of moving image signal in the first and second embodiments of the invention.

Fig. 3 is a diagram showing a constitution of a coding apparatus for realizing a coding method of moving image signal in third and fourth embodiments of the invention.

20           Fig. 4 is a diagram showing a constitution of a coding apparatus for realizing a coding method of moving image signal of prior art.

Fig. 5 is a diagram showing a detecting method of motion vector.

Fig. 6 is a diagram showing a constitution of a decoding apparatus for realizing a decoding method of moving image signal of prior art.

## Reference Numerals

	101	Variable length code decoding means
	102	Inverse quantizing means
	103	Inverse DCT
5	104	Frame memory A
	105	Motion compensation means A
	106	Intra/inter switch
	107	Reconstruction means
	108	Frame memory changeover switch
10	109	Frame memory B
	110	Motion compensation means B
	111	Predicted image selecting means
	112	Decoding error map A
	113	Decoding error map B
15	114	Decoding error map changeover switch
	301	Motion vector detecting means A
	302	Motion compensation means A
	303	Prediction error calculating means
	304	Intra/inter judging means

305	DCT
306	Quantizing means
307	Variable length code decoding means
308	Inverse quantizing means
5	309 Inverse DCT
	310 Reconstruction means
	311 Frame memory A
	312 Intra/inter switch
	313 Motion vector detecting means B
10	314 Motion compensation means B
	315 Predicted image combining means
	316 Frame memory B
	317 Frame memory changeover switch
	401 Motion vector detecting means
	402 Motion compensation means
	403 Prediction error calculating means
	404 Intra/inter judging means
15	405 DCT
	406 Quantizing means

407 Variable length code decoding means  
408 Inverse quantizing means  
409 Inverse DCT  
410 Reconstruction means  
5 411 Frame memory  
412 Intra/inter switch  
601 Variable length code decoding means  
602 Inverse quantizing means  
603 Inverse DCT  
10 604 Frame memory  
605 Motion compensation means  
606 Intra/inter switch  
607 Reconstruction means

### **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

15 Preferred embodiments of the invention are described below while referring to Fig. 1 to Fig. 3.

(First embodiment)

20 A first embodiment of the invention relates to a decoding method of moving image signal designed to select a predicted image to be used in reconstruction of present processing pixel block, depending on presence or

absence of decoding error contained in two or more predicted images.

The decoding method of moving image signal in the first embodiment of the invention is realized, as shown in Fig. 1, by a decoding apparatus comprising variable length code decoding means 101, inverse quantizing means 102, inverse DCT 103, frame memory A 104, motion compensation means A 105, intra/inter switch 106, reconstruction means 107, frame memory changeover switch 108, frame memory B 109, motion compensation means B 110, predicted image selecting means 111, decoding error map A 112, decoding error map B 113, and decoding error map changeover switch 114.

The operation of the decoding method of moving image signal in the first embodiment of the invention is described below. First, the decoding error map changeover switch 114 is set at the decoding error map B 113 side, and the frame memory changeover switch 108 is set at the frame memory B 109 side.

The variable length code decoding means 101 separates and decodes a variable length code from the entered bit stream, and issues quantizing coefficient, intra/inter control signal, motion vector A, and motion vector B in macro block unit, and also writes presence or absence of decoding error in the decoding error map B 113. The decoding error map is a memory for storing the decoded state about all macro blocks in one frame, by expressing, for example, a correctly decoded macro block as 1 and a macro block having decoding error as 0. In the decoding error map A 112, the decoded state one frame before in time from the present processing macro block is stored, and in the decoding error map B 113, the decoded state two frames before in time from the present processing macro block is stored.

In the variable length code decoding means 101, various means for detecting decoding error of macro block may be considered, and, for example, it

may be realized as follows. When decoding a moving image signal, if there is a bit error in the entered bit stream, all macro blocks from the bit having the error until a next synchronizing code (start code) appears cannot be decoded correctly. Generally, unless bit error detecting means is provided, macro blocks that cannot 5 be decoded correctly due to bit error cannot be identified. However, while decoding the bit stream from the wrong bit until appearance of next synchronizing code, (1) a variable length code not specified preliminarily may appear, (2) a value exceeding an allowable range may be decoded, and other contradictions may occur at high probability.

10 By making use of the character of (1) or (2), it may be possible to estimate that there is a decoding error in  $N$  macro blocks tracing back from the macro block having such decoding contradiction, and all macro blocks after the macro block generating decoding contradiction until appearance of synchronizing code. An example of  $N=4$  is shown in Fig. 2. In the example in Fig. 2, since 15 decoding contradiction took place when decoding the  $(n+5)$ -th macro block, it is estimated that there is a decoding error in all macro blocks from the  $(n+1)$ -th macro block, four macro blocks before, till the  $(n+7)$ -th macro block just before the synchronizing signal.

Consequently, the quantizing coefficient issued from the variable 20 length code decoding means 101 is inversely quantized by the inverse quantizing means 102, and is inversely transformed from the frequency region by the inverse DCT 103.

On the other hand, in the frame memory A 104, the reconstruction 25 image of one frame before in time from the present processing macro block is stored, and in the frame memory B 109, the reconstruction image of two frames before in time from the present processing macro block is stored. The motion vector A is a motion vector corresponding the frame memory A 104, and the

motion vector B is a motion vector corresponding to the frame memory B 109.

That is, the motion compensation means A 105 generates a predicted image A by displacing the pixel block of the reconstruction frame of one frame before stored in the frame memory A 104, according to the motion vector A. Similarly, the

5 motion compensation means B 110 generates a predicted image B by displacing the pixel block of the reconstruction frame of two frames before stored in the frame memory B 109, according to the motion vector B.

The predicted image selecting means 111 first identifies the position of the pixel block to be compensated of motion, by using the value of the entered

10 motion vector A. Comparing the position of this pixel block and the position of the error information stored in the decoding error map A 112, presence or absence of decoding error contained in the predicted image A is judged. Similarly,

predicted image selecting means 111 judges presence or absence of decoding error contained in the predicted image B, from the contents of the value of the entered

15 motion vector B and decoding error map B 113. When judging that a decoding error is contained in the predicted image A, the predicted image selecting means 111 issues only the predicted image B, or, to the contrary, when judging that a

decoding error is contained in the predicted image B, it issues only the predicted image A. If it is judged that error is not contained in either predicted image A or

20 predicted image B, the average of the predicted image A and predicted image B is calculated and issued in the pixel unit.

If it is judged that error is contained in both predicted image A and predicted image B, the average of the predicted image A and predicted image B may be calculated and issued in the pixel unit, the predicted image A may be issued, or the predicted image B may be issued, as determined preliminarily.

When the intra/inter control signal issued from the variable length code decoding means 101 instructs intra-coding, the intra/inter switch 106 is

turned off, and the output from the inverse DCT 103 is directly stored in the frame memory B 109. On the other hand, when the intra/inter control signal instructs inter-coding, the intra/inter switch 106 is turned on, and the output of the inverse DCT 103 and the output of the predicted image selecting means 111 are added in the reconstruction means 107, and stored in the frame memory B 109. Thus, the present reconstruction frame is stored in the frame memory B 109, and it is issued as decoded image.

After completion of decoding process of the present frame, the decoding error map changeover switch 114 is changed over to the decoding error map A 112 side, and the frame memory changeover switch 108 is changed over to the frame memory A 104 side. By this changeover, in decoding of next frame, the decoded state of two frames before in time is stored in the decoding error map A 112, and the decoded state of one frame before in time is stored in the decoding error map B 113. Likewise, the reconstruction image of two frames before in time is stored in the frame memory A 104, and the reconstruction image of one frame before in time is stored in the frame memory B 109.

In the first embodiment of the invention, since the decoding method of moving image signal is thus constituted, by using only the predicted image not containing decoding error in reconstruction of the present processing pixel block, the picture quality deterioration due to decoding error is prevented from propagating into the frames subsequent in time.

In the decoding method of moving image signal of the invention, the decoding error map and frame memory are provided by two pieces each, but by using three pieces or more, the decoded state and reconstruction image of three frames or more before in time may be stored. Incidentally, the means for estimating the macro block having decoding error by decoding contradiction, and the means for judging decoding error contained in the predicted image by using

the decoding error map are only example, and they may be composed of other means.

(Second embodiment)

A second embodiment of the invention relates to a decoding method  
5 of moving image signal, in which if decoding error is not contained in plural predicted images out of two or more predicted images, the predicted image produced from the latest decoded frame in time out of the predicted images free from decoding error is used in reconstruction of the present processing pixel block.

10 The decoding method of moving image signal of the second embodiment of the invention is realized by the same decoding apparatus as in the first embodiment shown in Fig. 1. The operation of the decoding method of the moving image signal of the second embodiment of the invention is described below. The operation other than that of the predicted image selecting means 111  
15 is not particularly different from that in the first embodiment.

In the predicted image selecting means 111, if it is judged that there is no error contained in either predicted image A or predicted image B, it is constituted to issue the newer one of the predicted image A or predicted image B. That is, if it is judged that error is not contained in either predicted image A or  
20 predicted image B, it is constituted to issue always only the predicted image produced from the reconstruction image of one frame before.

In the decoding method of the moving image signal realized in the decoding apparatus shown in Fig. 1, the decoding error map and frame memory are provided by two pieces each, but by using three pieces or more, the decoded state and reconstruction image of three frames or more before in time may be stored. If there are three predicted images, supposing, for example, there is an  
25

error in the latest predicted image A, out of predicted image A, predicted image B, and predicted image C, and no error in the predicted image B and predicted image C, it is constituted to issue the latest predicted image B out of the predicted image B and predicted image C. It is the same if there are four or more images.

5 If all predicted images are wrong, one predetermined predicted image may be issued.

In the second embodiment of the invention, since the decoding method of the moving image signal is thus constituted, the correlation of the present processing pixel block to be reconstructed and the predicted image is 10 heightened due to similarity of moving images in time, so that the code quantity necessary for reconstruction of present processing block is decreased.

(Third embodiment)

A third embodiment of the invention is a coding method of moving image signal for inter-coding the present processing pixel block when the 15 correlation is high between two or more predicted images compensated of motion by two or more motion vectors, and intra-coding the present processing pixel block when the correlation is low between two or more predicted images.

The coding method of the moving image signal of third embodiment of the invention is realized, as shown in Fig. 3, by the coding apparatus 20 comprising motion vector detecting means A 301, motion compensation means A 302, prediction error calculating means 303, intra/inter judging means 304, DCT 305, quantizing means 306, variable length code decoding means 307, inverse quantizing means 308, inverse DCT 309, reconstruction means 310, frame memory A 311, intra/inter switch 312, motion vector detecting means B 313, 25 motion compensation means B 314, predicted image combining means 315, frame memory B 316, and frame memory changeover switch 317.

The operation of the coding method of moving image signal of the third embodiment of the invention is described below. First, the frame memory changeover switch 317 is supposed to be set at the frame memory B 316 side.

To begin with, the motion vector detecting means A 301 detects the 5 motion vector A by the reconstruction frame stored in the frame memory A 311 and the entered present frame. Similarly, the motion vector detecting means B 313 detects the motion vector B by the reconstruction frame stored in the frame memory B 316 and the entered present frame. Herein, in the frame memory A 311, the reconstruction image of one frame before in time from the present 10 processing macro block is stored, and in the frame memory B 316, the reconstruction image of two frames before in time from the present processing macro block is stored.

The motion compensation means A 302 generates a predicted image A by displacing the pixel block of the reconstruction frame of one frame before 15 stored in the frame memory A 311, according to the motion vector A. Similarly, the motion compensation means B 314 generates a predicted image B by displacing the pixel block of the reconstruction frame of two frames before stored in the frame memory B 316, according to the motion vector B. The predicted image combining means 315 calculates and issues the average of the entered 20 predicted image A and predicted image B in the pixel unit. The prediction error calculating means 303 calculates the difference of the macro block of the entered present frame and the output of the predicted image combining means 315 in the pixel unit, and issues as prediction error.

Further, the macro block of the present frame, this prediction error, 25 and the predicted image A and predicted image B are entered into the intra/inter judging means 304. Herein, as the processing at first stage, for example, by comparing the variance of pixels in the macro block of the present frame and the

variance of the prediction error, it is judged whether the macro block of the present frame is processed by intra-coding or inter-coding. If the inter-coding is judged as a result of processing at the first stage, the correlation between the predicted image A and predicted image B is evaluated as the processing at second 5 stage, and it is judged whether the macro block of the present frame is processed by intra-coding or inter-coding.

Evaluation of correlation of predicted image A and predicted image B and intra/inter judgement at the second stage are executed, for example, as follows. First, the absolute differential sum of predicted image A and predicted 10 image B is calculated in the pixel unit. If the absolute differential sum is larger than a predetermined threshold, the correlation is small, and the macro block of the present frame is judged to be processed by intra-coding. To the contrary, if the absolute differential sum is larger than the predetermined threshold, the correlation is large, and the macro block of the present frame is judged to be 15 processed by inter-coding.

According to the result of judgement by the intra/inter judging means 304 consisting of the processing in the first stage and second stage, either the macro block of the present frame or the pertinent prediction error is issued. At the same time, the result of judgement is also issued as intra/inter control 20 signal. The macro block of the present frame or the pertinent prediction error issued from the intra/inter judging means 304 is put into the variable length coding means 307 through the DCT 305 and quantizing means 306. In the variable length coding means 307, the intra/inter control signal, and motion vector A and motion vector B are also entered, and are coded into variable length codes. The 25 variable length coding means 307 multiplexes all these variable length codes, and issues as a bit stream.

On the other hand, the quantizing coefficient which is the output of

the quantizing means 306 is put into the reconstruction means 310 through the inverse quantizing means 308 and inverse DCT 309. When the macro block being presently coded is intra-coding, the intra/inter switch 312 is turned off, and the output from the inverse DCT 309 is directly stored in the frame memory B 316.

5 To the contrary, when the macro block being presently coded is inter-coding, the intra/inter switch 312 is turned on, and the output of the inverse DCT 309 and the output of the predicted image combining means 315 are added in the reconstruction means 310, and stored in the frame memory B 316. Thus, the present reconstruction frame is stored in the frame memory B 316.

10 After completion of coding process of the present frame, the frame memory changeover switch 317 is changed over to the frame memory A 311 side. By this changeover, in coding of next frame, the reconstruction image of two frames before in time is stored in the frame memory A 311, and the reconstruction image of one frame before in time is stored in the frame memory B 316.

15 In the third embodiment of the invention, since the coding method of moving image signal is thus constituted, if a predicted image different from the coding side is selected in the decoding method of moving image signal, inter-coding is effected only when the correlation between predicted images is high, so 20 that mis-matching of the predicted images may be kept to a minimum limit.

25 In the coding method of moving image signal of the third embodiment, two frame memories are provided, but by using three or more, the reconstruction image of three frames or more before in time may be stored. Incidentally, the means for evaluating the correlation of the predicted image A and predicted image B is only an example, and it may be composed of other means.

(Fourth embodiment)

A fourth embodiment of the invention relates to a coding method of moving image signal for using the predicted image produced from the latest decoded frame in time out of two or more predicted images compensated of motion by two or more motion vectors in coding of the present processing pixel block.

5

The coding method of moving image signal of the fourth embodiment of the invention is realized by the same coding apparatus as in the third embodiment shown in Fig. 3. The operation of the coding method of the moving image signal of the fourth embodiment of the invention is described 10 below. The operation other than that of the predicted image combining means 315 is not particularly different from that in the third embodiment.

10

The predicted image combining means 315 is constituted so as to issue only the newer one of the predicted image A or predicted image B. That is, it is constituted to issue always only the predicted image produced from the 15 reconstruction image of one frame before. If three or more frame memories are used and the reconstruction image of three frames or more before in time is stored, only the latest predicted image may be issued.

15

20

In the fourth embodiment of the invention, since the coding method of the moving image signal is thus constituted, the prediction error about the present processing pixel block is smaller owing to the similarity of moving images in times, and the generated code quantity is smaller.

20

25

Thus, according to the invention, since the present processing pixel block is reconstructed by selecting the predicted image free from decoding error, the picture quality deterioration due to decoding error does not propagate in time, so that deterioration of reproduced picture quality due to bit error occurring in transmission or accumulation of bit stream may be kept to a minimum limit.

**What is claimed is:**

1           1. A decoding method of moving image signal, being a decoding  
2   method of moving image signal for decoding at least two or more motion vectors  
3   relating to the present processing pixel block, compensating the motion of the  
4   decoded frame corresponding to each one of said two or more motion vectors, and  
5   generating two or more predicted images relating to the present processing pixel  
6   block,

7           wherein the predicted image used in reconstruction of the present  
8   processing pixel block is selected depending on presence or absence of decoding  
9   error contained in said two or more predicted images.

1           2. A decoding method of moving image signal of claim 1, wherein  
2   if there are plural predicted images free from decoding error in said two or more  
3   predicted images,

4           the predicted image produced from the latest decoded frame in time  
5   out of said plural predicted images free from decoding error is used in  
6   reconstruction of the present processing pixel block.

1           3. A coding method of moving image signal, being a coding method  
2   of moving image signal for detecting and coding at least two or more motion  
3   vectors relating to the present processing pixel block, characterized by:

4           inter-coding the present processing pixel block when the correlation  
5   of two or more predicted images compensated of motion by said two or more  
6   motion vectors is high, and

7           intra-coding the present processing pixel block when the correlation  
8   of said two or more predicted images is low.

1           4. A coding method of moving image signal, being a coding method  
2        of moving image signal for detecting and coding at least two or more motion  
3        vectors relating to the present processing pixel block, characterized by:

4           using the predicted image produced from the latest decoded frame in  
5        time out of two or more predicted images compensated of motion by said two or  
6        more motion vectors is used in coding of the present processing pixel block.

1           5. A decoding apparatus of moving image signal comprising:

2           variable length code decoding means for decoding at least two or  
3        more motion vectors relating to the present processing pixel block,

4           motion compensation means for compensating the motion of coded  
5        frame corresponding to each one of said two or more motion vectors, and  
6        generating two or more predicted images relating to the present processing pixel  
7        block,

8           bit error detecting means for detecting a bit error from the output of  
9        said variable length code decoding means,

10           memory means for storing the bit error detecting result of said bit  
11        error detecting means, and

12           predicted image selecting means for recognizing presence or absence  
13        of decoding error contained in said two or more predicted images, and selecting  
14        the predicted image to be used in reconstruction of the present processing pixel  
15        block.

1           6. A decoding apparatus of moving image signal of claim 5,  
2        wherein the bit error detecting means detects bit error in the pixel block when the  
3        variable length code of the pixel block decoded by the variable length code

4 decoding means is contradictory to a specified standard.

1           7. A decoding apparatus of moving image signal of claim 5,  
2 wherein the memory means stores bit errors in plural frames by plotting the pixel  
3 blocks in which bit error is detected in each frame in a map form.

1           8. A decoding apparatus of moving image signal of claim 7,  
2 wherein the memory means comprises plural decoding error map memories  
3 storing each frame consecutive in time, and also has changeover means, and  
4 therefore said plural decoding error map memories are changed over by said  
5 changeover means, and issued.

1           9. A coding apparatus of moving image signal comprising:

2           motion vector detecting means for detecting at least two or more  
3 motion vectors relating to the present processing pixel block,

4           motion compensation means for issuing plural predicted images from  
5 the output of said motion vector detecting means, and

6           intra/inter judging means for inter-coding the present processing  
7 pixel block when the correlation of two or more predicted images compensated of  
8 motion by said two or more motion vectors as the output of said motion  
9 compensation means is high, and intra-coding the present processing pixel block  
10 when the correlation of said two or more predicted images is low.

1           10. A coding apparatus of moving image signal of claim 9, further  
2 comprising:

3           predicted image combining means for combining two or more  
4 predicted images compensated by said two or more motion vectors, and

-23-

5 prediction error calculating means for calculating the prediction  
6 error from the output of said predicted image combining means and the macro  
7 block of the present frame,

8 wherein the intra/inter judging means judges before processing by  
9 comparing the variance of present processing pixel block and the variance of  
10 prediction error from the output of the prediction error calculating means to judge  
11 processing before intra/inter coding, and processes next intra/inter judgement only  
12 when judged to be inter-coding.

1 11. A coding apparatus of moving image signal of claim 10,  
2 wherein said predicted image combining means issues predicted image produced  
3 from the latest decoded frame in time out of two or more predicted images  
4 compensated of motion by said two or more motion vectors for use in coding of  
5 the present processing pixel block.

## ABSTRACT

A decoding method and coding method of moving image signal, and a decoding apparatus and coding apparatus using the same, provides for coding or decoding at least two or more motion vectors, relating to the present processing pixel block, compensating the motion of the coded frame corresponding to each motion vector, generating two or more predicted images relating to the present processing image block, and selecting the predicted image for use in reconstruction of the present processing pixel block depending on presence or absence of decoding error contained in these two or more predicted images.

5                    Accordingly, if a decoding error occurs due to bit error in the bit stream, propagation of picture quality deterioration in time can be suppressed, so that excellent decoding of digital moving image signal is realized.

10

# Declaration and Power of Attorney For Patent Application

## English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

DECODING AND CODING METHOD OF MOVING IMAGE SIGNAL, AND DECODING AND CODING APPARATUS OF MOVING IMAGE SIGNAL USING THE SAME,

the specification of which is attached hereto unless the following box is checked:

was filed on \_\_\_\_\_ as  
United States Application Number or PCT International Application Number \_\_\_\_\_  
and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)	Priority Not Claimed		
9-94478 (Number)	Japan (Country)	31 March 1997 (Day/Month/Year Filed)	<input type="checkbox"/>
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/>

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

_____ (Application Number)	_____ (Filing Date)
_____ (Application Number)	_____ (Filing Date)

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)

(Filing Date)

(Status - patented, pending, abandoned)

(Application Number)

(Filing Date)

(Status - patented, pending, abandoned)

**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

Paul F Prestia	Reg No 23,031	Robert L Andersen	Reg No 25,771	Rocco L Adornato	Reg No 40,480
Allan Ratner	Reg No 19,717	Lawrence E Ashery	Reg No 34,515	Jacques L Etkowicz	Reg No P41,738
Andrew L Ney	Reg No 20,300	Christopher R Lewis	Reg No. 36,201	Eric A Dichter	Reg No P41,708
Kenneth N Nigon	Reg No 31,549	Steven E Koffs	Reg No 37,163	Mark J Marcelli	Reg No 36,593
Kevin R Casey	Reg No 32,117	Allan M Wheatcraft	Reg No 36,307		
Benjamin E Leace	Reg. No 33,412	Louis W Beardell, Jr	Reg. No 40,506		
James C Simmons	Reg No 24,842	Ian M Hughes	Reg No 41,083		

Address all correspondence to: Lawrence E. AsheryRatner & Prestia, Suite 301, One Westlakes, Berwyn, P O. Box 980, Valley Forge, PA 19482-0980Address all telephone calls to: Lawrence E. Ashery at (610) 407-0700.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor (given name, family name) Yutaka Machida

Inventor's signature \_\_\_\_\_ Date \_\_\_\_\_

Residence 1114-C-101, Kamisugeta-cho, Hodogaya-ku, Yokohama-shi, Kanagawa, 240 JapanCitizenship JapanesePost Office Address 1114-C-101, Kamisugeta-cho, Hodogaya-ku, Yokohama-shi, Kanagawa, 240 Japan

Full name of second joint inventor, if any (given name, family name) \_\_\_\_\_

Second Inventor's signature \_\_\_\_\_ Date \_\_\_\_\_

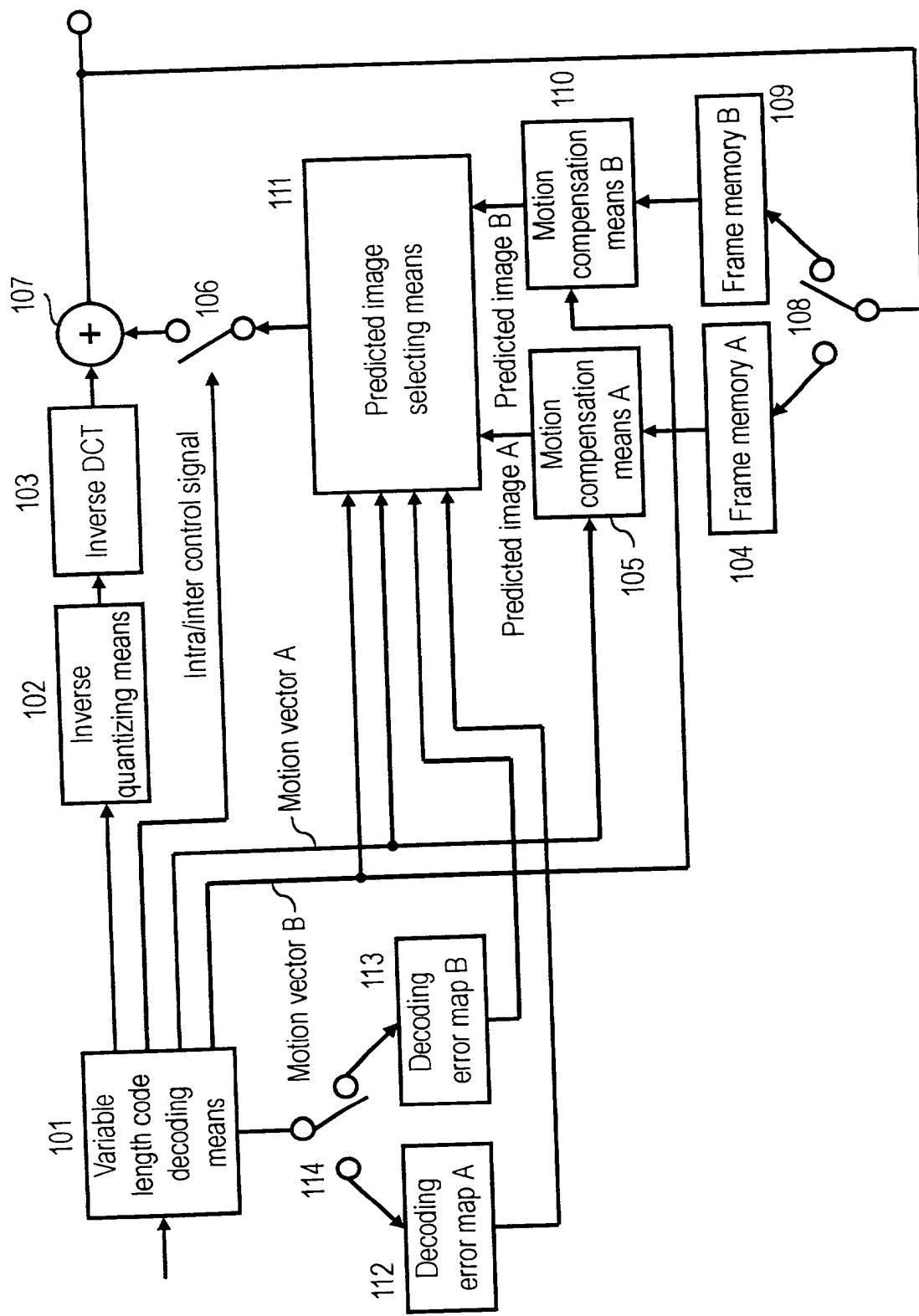
Residence \_\_\_\_\_

Citizenship \_\_\_\_\_

Post Office Address \_\_\_\_\_

Additional inventors are being named on separately numbered sheets attached hereto

FIG. 1



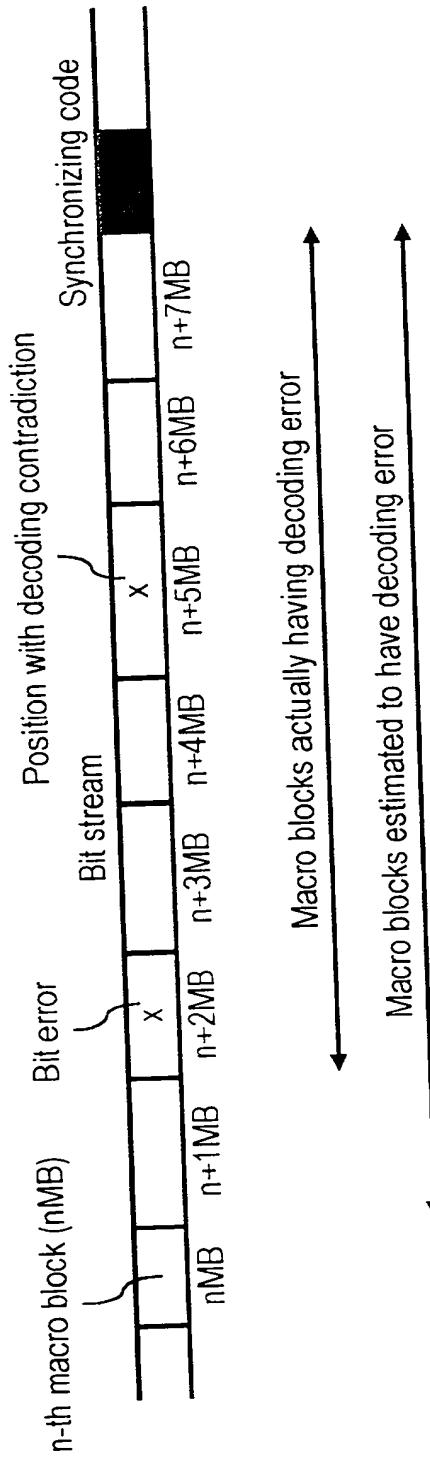


FIG. 2

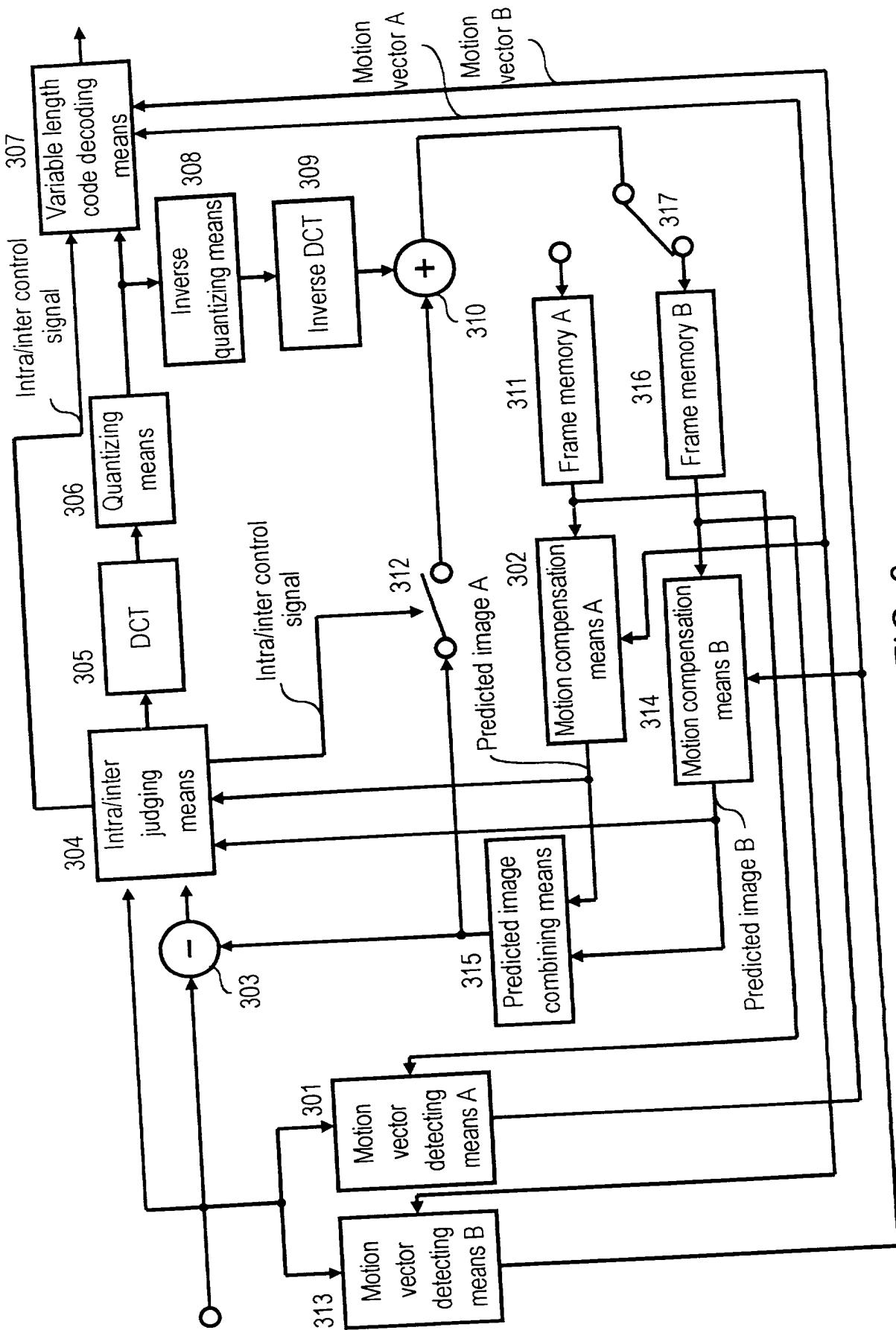


FIG. 3

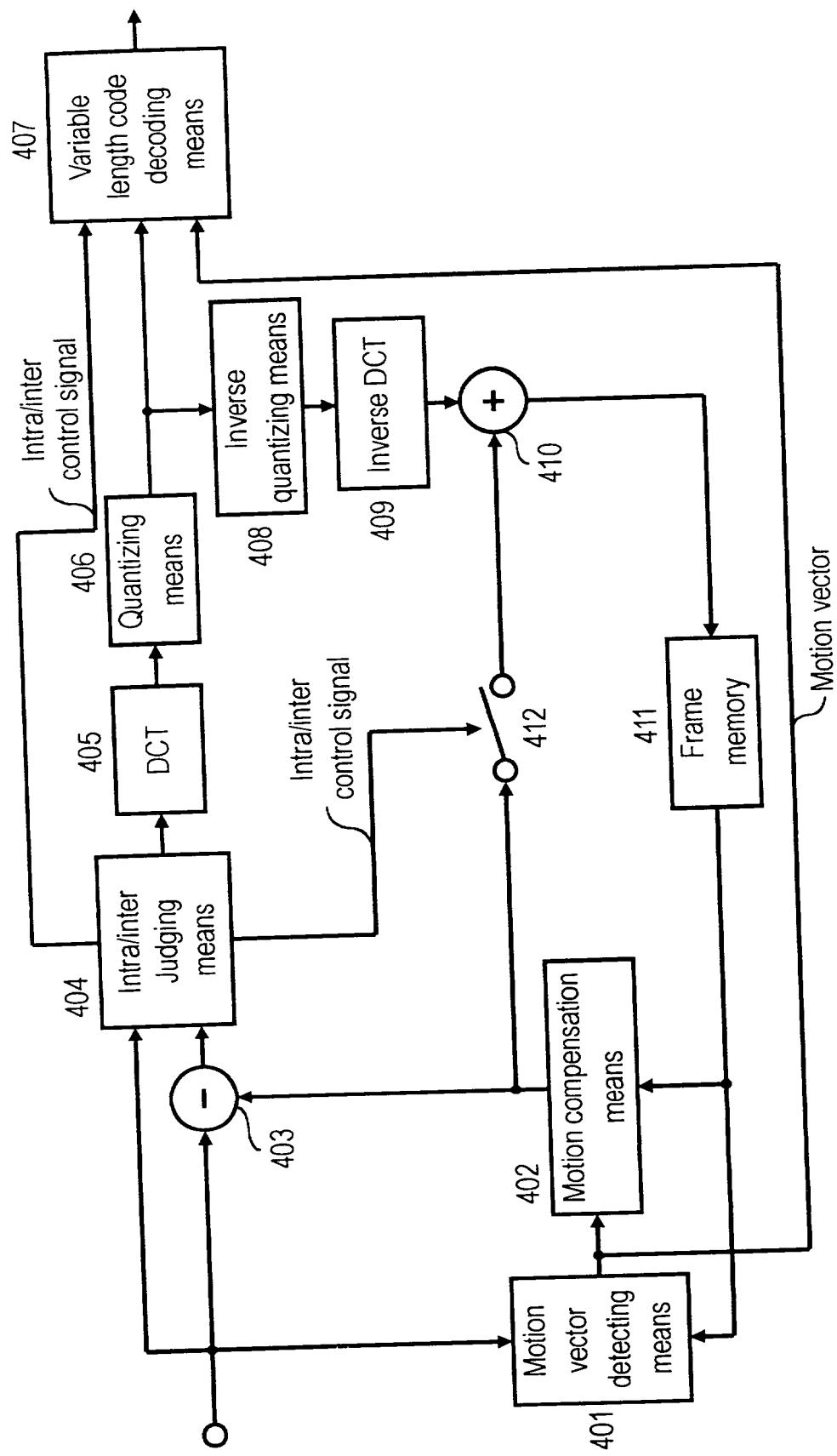


FIG. 4

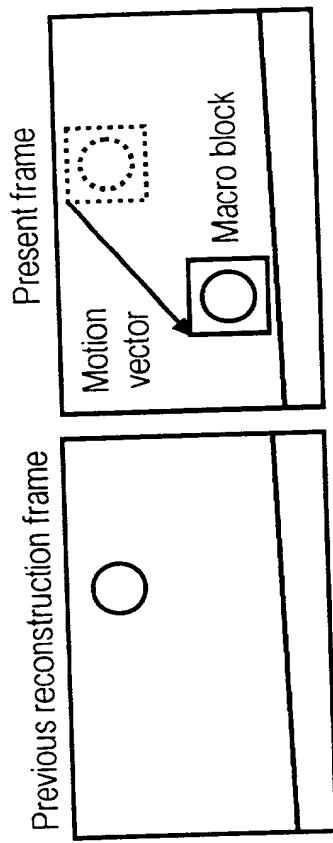


FIG. 5

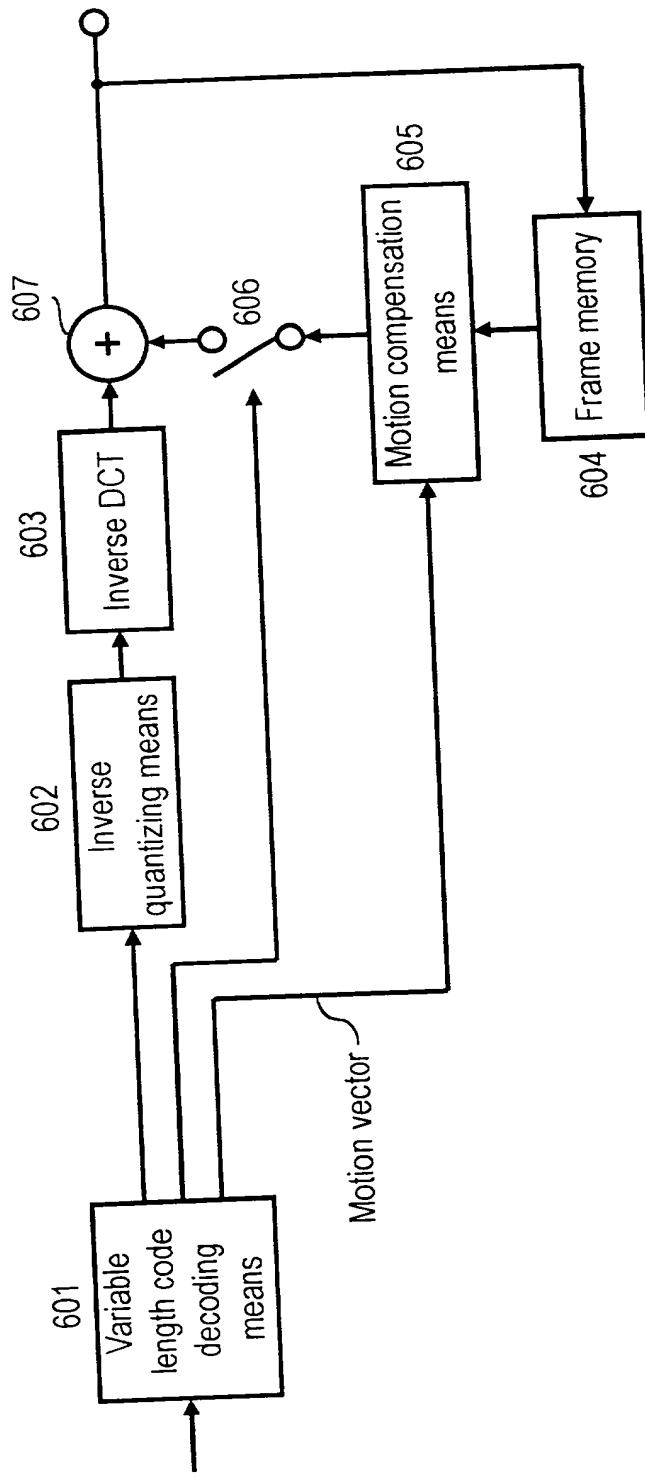


FIG. 6